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REF. 4 BOA P4000151
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A 5



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 :
H04N 5/445

A1

(11) International Publication Number: WO 00/59213

(43) International Publication Date: 5 October 2000 (05.10.00)

(21) International Application Number: PCT/US00/08591

(22) International Filing Date: 31 March 2000 (31.03.00)

(30) Priority Data:
60/127,270 31 March 1999 (31.03.99) US

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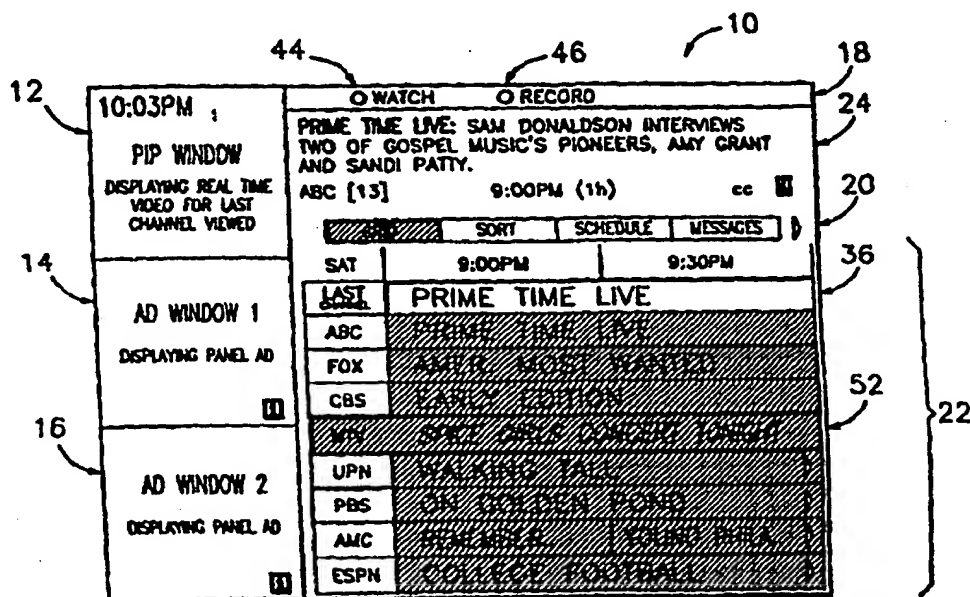
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(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG,
BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE,
ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP,
KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA,
MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU,
SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG,
US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE,
LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM,
AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT,
BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU,
MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM,
GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published

With international search report.
With amended claims.

(54) Title: DECIMATION METHOD FOR PROVIDING PIG WINDOWS



(57) Abstract

A decimation system and method for providing video data to a PIG window in a EPG environment. In one embodiment, the system includes an EPG system having a picture in guide window, a tuner to generate a video signal, a decoder coupled to the tuner to receive the video signal and generate pixels based on the received signal, a PIG generator coupled to the decoder that performs a real time weighted averaging to select a subset of the pixels; and a display generator to display the subset of the pixels in the PIG window on a monitor.

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DECIMATION METHOD FOR PROVIDING PIG WINDOWS

BACKGROUND OF THE INVENTION

The present invention relates generally to graphical/video display systems and methods, and in particular to methods and systems for optimizing graphical/video displays, such as Picture-In-Guide ("PIG") windows and their memory requirements.

Generally, televisions and television systems, such as computers to operate as televisions, provide information to a user through a display. One example is an electronic program guide ("EPG"). An EPG provides a user or television viewer with updatable television schedule information in the form of an on-screen graphical display. The EPG may provide scheduling information for current and future broadcast programs as well as summaries of television program content for a particular program. The EPG may also provide one or more regions (windows) for previewing different television programs simultaneous with the displayed schedule information or with broadcast of the television program. Often the EPG divides the display into multiple portions or regions of varying size and resolution to provide multiple types of information.

Conventionally, most television systems do not optimally use their available resources, such as memory space or processor bandwidth to effectively and efficiently provide information through the PIG window to a user. Therefore, there is a need for a method and system for providing a real-time and high quality video in a smaller PIG screen with minimum memory requirement.

SUMMARY OF THE INVENTION

The present invention is a decimation system and method for providing video data to a PIG window. One video pixel for every several video pixels is output, in real time, for the PIG window based on some (pixel) averaging algorithms. In one embodiment, only the two previous pixel lines are buffered, eliminating the need for buffering of the entire frame. This system produces real-time and high quality video in a smaller PIG screen with minimum memory requirement.

In one embodiment, the system of the present invention includes an EPG system having a picture in guide window, a tuner to generate a video signal, a decoder coupled to the tuner to receive the video signal and generate pixels based on the received signal, a PIG generator coupled to the decoder that performs a real time weighted averaging to select a subset of the pixels; and a display generator to display the subset of the pixels in the PIG window on a monitor.

Many of the features of this invention will be more readily appreciated as the same becomes better understood by reference to the following detailed description and considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exemplary PIG display of an EPG according to one embodiment of the present invention;

FIG. 2 is a simplified exemplary block diagram of a television system that includes a decimation system according to one embodiment of the present invention;

FIG. 3 is an exemplary averaging window for three pixel lines according to one embodiment of the present invention.

DETAIL DESCRIPTION

This invention relates to a decimation system and method for providing video data to a PIG window, preferably in an EPG. In one embodiment of the present invention, one video pixel for every several video pixels is output for the PIG window based on some (pixel) averaging algorithms. The earliest versions of on-screen EPGs provided for the storage of program schedule information in an electronic memory connected to the television receiver and generally provided for the on-screen formatting and display of the program schedule information on the television screen. The early EPGs typically overlaid the television programming. Later EPGs provided PIG display of the television program simultaneous with the display of the EPG. In PIG format, the moving, real time images of one television channel are displayed on the background of the EPG in a PIG window overlaid on a small area of the background.

The PIG display, according to one embodiment of the present invention, includes a real-time video image of a tuned television program displayed in a small window inset in a larger graphic guide. The PIG display provides many options to the viewer. The viewer may continue to view the television program s/he was watching before entering the guide while browsing through the television scheduling information in the guide. Alternatively, the program displayed in the PIG window may change for corresponding to a selected channel in the guide as the viewer cursors through program listings in the guide. The viewer may also pull up the PIG display to find out more information about the program s/he is currently watching, such as start/stop time or a program synopsis, while continuing to view the program in the inset PIG window.

FIG. 1 illustrates a PIG display 10 of an electronic program guide (EPG) including a grid portion 22 and a picture window 12. The picture window 12, hereafter referred to as the PIG window, contains a video image of the television program displayed in the full-screen video display, but in reduced size, generally reduced by a factor of three in both width and height, i.e., 1/9 the size of the screen. However, other reduction factors are also possible and are within the scope of the invention. Below window 12 are Panel Ad Windows 14, and 16 ("Ad Windows"). Windows 12, 14, and 16 each typically occupy about 1/9 of the total screen area. Another possible screen for display in a PIG system is a full-screen graphics display. The PIG window may also be used to display advertisement including text and video previews of goods, services, or television programs.

1 The grid portion 22 of the PIG display 10 takes up a majority of the screen. The grid
portion generally includes text, icons, and background graphics of several different colors. The
graphics may include highlighting of text or sections of the screen. In an EPG system, the viewer
can generally navigate through different guides without changing the television program
5 displayed in the PIG window 12. The remainder of the screen area is typically occupied (moving
from top to bottom of the screen) by an action key bar 18, a navigation bar 20, and an information
box 24 (the "detailed information area").

10 In one embodiment of the present invention, when the viewer places a cursor on a different
channel designation 52 or program title in the grid portion, the system automatically tunes the
associated tuner to the selected channel and displays the program broadcast on that channel in
the PIG window 12.

15 According to one embodiment of the invention, the components necessary to generate a
PIG display 10 are provided on a single chip to be incorporated into televisions, PC/TVs, VCRs,
stand-alone units, satellite receivers, or the like. By providing all the components on a single
chip, the overall package size can be reduced as well as the overall gate count and bus interface
size of that chip.

20 FIG. 2 is a block diagram of the components of one embodiment of the invention provided
on a single chip 21. These include a microprocessor 30, a memory controller or direct memory
access (DMA) device 31, synchronization regenerating (synch) circuitry 28 and 78, VBI slicer
37, NTSC decoder 79, PIG generator 32, pixel clock generator 38, display generator 34, color
space converter 60, digital-to-analog conversion (DAC) 36, digital video output 80.

25 The microprocessor 30 configures and coordinates the activities of all of the other
components on the chip 21 via two-way communication paths without participating in any data
movement operations, such as the VBI slicer 37 writing EPG data to memory via the DMA
engine 31. The microprocessor 30 accesses RAM 26 using the DMA engine 31 as a proxy by
providing address information and either providing data (in the case of a write) or receiving data
(in the case of a read).

30 Preferably, there is only one RAM, although this invention will work with any number of
RAMs. This RAM and the microprocessor 30 may be part of the chip 21 or may be external.
The decision of internal versus external RAM and/or microprocessor is driven by economic and
technological constraints. RAM 26 is accessed by four different components: the microprocessor
30, the PIG generator 32, the VBI slicer 37, and the display generator 34. This places a high
access load on the RAM as all four components may vie for access to the RAM simultaneously.
If all access requests cannot be satisfied simultaneously (either by using a RAM that can access
35 several bytes per cycle or using several RAMs or using a RAM whose cycle time is several times
faster than the chip cycle time), a multiplexing device is necessary to resolve the arbitration
between the components. Accordingly, the microprocessor 30, PIG generator 32, VBI slicer 37,
and the display generator 34 each access the RAM 26 through the DMA 31. The DMA is a

1 multiplexing and arbitrating circuit that facilitates the sharing of the RAM 26 by switching access
between the four components in turn. The DMA may include buffer memory to temporarily store
data input from out-of-turn components between access cycles. The DMA 31 stores text and
video data in the correct addresses in the RAM 26 and then retrieves the appropriate data from
5 a selected address from the RAM 26 when needed.

In one embodiment, the system can receive two independent video signals from two
independent tuners 50. In a unit with two tuners, this allows chip 21 to collect data from one
channel while the user is in the guide viewing a different channel. Other embodiments with more
than two tuners for receiving more than two video signals to display in a plurality of PIG
10 windows are also possible. In a unit with one tuner, both video inputs would be connected to the
one tuner.

The picture video input 76 from one of the tuners 50 is connected to the NTSC decoder
79. The NTSC decoder takes an analog input and outputs digital pixels either R,G,B or Y,U,V
in sufficient resolution for the desired PIG picture quality.

15 To implement a low-cost PIG device for use in a PIG system, the incoming video data is
decimated before the video data is stored in a memory device. Thus the resulting PIG has a
limited resolution. In one embodiment, a weighted averaging algorithm is used to select one
pixel out of nine pixels (decimation by 9). The incoming digitized video data is buffered in a
low-cost memory, such as a shift register, to carry out the averaging algorithm.

20 For example, for an immediate neighbor averaging, the adjacent pixels in a sliding
window (nine pixels) for the current line, the two previous lines are stored in the buffer (shift
register) and the desired averaging function is performed on them to obtain one weighted pixel
for each nine pixels. The resulting pixel is then converted to video signal for display in a PIG
window, or it is stored in memory to be used for PIG window display. For a nine pixel sliding
25 window, only two previous lines of video data need to be buffered.

Referring now to FIG. 3, sliding window 130 contains nine pixels. The two previous lines
l and m are buffered. When pixel P_{nj}+1 of the new line n arrives, the averaging algorithm is
performed, and the resulting (weighted) pixel is output in real time. When the next pixel P_{nj}+2
arrives, it is buffered but, the averaging algorithm is not performed until P_{nj}+3 and P_{nj}+4 arrive.
30 As P_{nj}+4 arrives, the sliding window shifts to the right by three pixels to position 131. The
averaging algorithm is performed and again, the next (weighted) pixel is output in real time.
When the end of line is reached, the sliding window moves down by three pixels to the
beginning of lines L_{n+1}, L_{n+2}, and L_{n+3}. No decimation is carried out until lines L_{n+1} and
L_{n+2} are buffered. Once lines L_{n+1} and L_{n+2} are buffered, the decimation continues as
35 indicated above.

The following illustrates an example for a polynomial weighted averaging algorithm:

Field	Line	Pixels								
1	1	1	2	3	4	5	6	7	8	9
2	1	1	2	3	4	5	6	7	8	9
1	2	1	2	3	4	5	6	7	8	9
2	2	1	2	3	4	5	6	7	8	9
1	3	1	2	3	4	5	6	7	8	9
2	3	1	2	3	4	5	6	7	8	9

As field 1, line 1 is received, pixels 1, 2, and 3 are summed together and stored, similarly for 4, 5, and 6 and 7, 8, and 9. The same procedure is used for line 3. The procedure is repeated for every line in field 1. When field 2 is received, field 2, line 1 is added to field 1, line 1 and field 1, line 3. Field 2, line 2 and field 2, line 3 are added to field 1, line 3, etc.

Note: pixel locations are marked (field-line-pixel). A field is assumed to have lines 1 - 240 inclusive active video lines. Each line is assumed to have 640 pixels.

The locations in memory after the first field is received would be:

memory[1] = (1-1-1) + 2*(1-1-2) + (1-1-3) + (1-2-1) + 2*(1-2-2) + (1-2-3)

memory[2] = (1-1-4) + 2*(1-1-5) + (1-1-6) + (1-2-7) + 2*(1-2-8) + (1-2-9)

...

...

memory[213] = (1-1-637) + 2*(1-1-638) + (1-1-639) + (1-2-637) + 2*(1-2-638) + (1-2-639)

memory[214] = 2*(1-3-1) + 4*(1-3-2) + 2*(1-3-3)

memory[215] = 2*(1-3-4) + 4*(1-3-5) + 2*(1-3-6)

...

memory[426] = 2*(1-3-637) + 4*(1-3-638) + 2*(1-3-639)

...

memory[33868] = 2*(1-240-1) + 4*(1-240-2) + 2*(1-240-3)

...

memory[34080] = 2*(1-240-637) + 4*(1-240-638) + 2*(1-240-639)

As the second field is received, the following pixels are output:

pixel[1] = {memory[1] + 2*(2-1-1) + 4*(2-1-2) + 2*(2-1-3)}/16

pixel[2] = {memory[2] + 2*(2-1-4) + 4*(2-1-5) + 2*(2-1-6)}/16

...

pixel[213] = {memory[213] + 2*(2-1-637) + 4*(2-1-638) + 2*(2-1-639)}/16

pixel[214] = {memory[214] + (2-2-1) + 2*(2-2-2) + (2-2-3) + (2-3-1) + 2*(2-3-2) + (2-3-3)}/16

...

1 The memory is updated with terms involving field 2 only.

memory[1] = $2*(2-1-1) + 4*(2-1-2) + 2*(2-1-3)$

memory[2] = $2*(2-1-4) + 4*(2-1-5) + 2*(2-1-6)$

...

5 memory[213] = $2*(2-1-637) + 4*(2-1-638) + 2*(2-1-639)$

memory[214] = $(2-2-1) + 2*(2-2-2) + (2-2-3) + (2-3-1) + 2*(2-3-2) + (2-3-3)$

...

As the next field 1 is received the output pixels are:

10 pixel[1] = {memory[1] + (1-1-1) + 2*(1-1-2) + (1-1-3) + (1-2-1) + 2*(1-2-2) + (1-2-3)}/16

and so on....

This algorithm converts every nine pixels into one pixel using polynomial weighted averaging with binary coefficients, without having to store the entire frames. As a result, a PIG window of a one-ninth the size of the original display window is generated. The picture is de-interlaced before the averaging and then re-interlaced after the averaging is completed.

Assuming the binary coefficients for the nine-pixel window are

a, b, c,

d, e, f,

g, h, i,

20 in one embodiment, the transfer function performed by the algorithm is: $(a + 2b + c + 2d + 4e + 2f + g + 2h + i)/16$. The averaging algorithm is performed in real time before the video data is stored. A minimum amount of memory is needed because only the two previous lines of each field, sufficient for carrying out the algorithm, are stored. The algorithm also counter balances the motion effects by assigning a heavier weight to the center pixel (i.e., 4e).

25 It will be recognized by those skilled in the art that various modifications may be made to the illustrated and other embodiments of the invention described above, without departing from the broad inventive scope thereof. It will be understood therefore that the invention is not limited to the particular embodiments or arrangements disclosed, but is rather intended to cover any changes, adaptations or modifications which are within the scope and spirit of the invention

30 as defined by the appended claims.

35

1 WHAT IS CLAIMED IS:

1. An electronic program guide (EPG) system including a picture in guide (PIG) window comprising:

5 a monitor having a display screen;
a tuner to generate a video signal;
a decoder coupled to the tuner to receive the video signal and generate pixels based on the received signal;

10 a PIG generator coupled to the decoder that performs a real time weighted averaging to select a subset of the pixels; and

a display generator to display the subset of the pixels in the PIG window on the display screen.

15 2. The EPG system of claim 1, wherein the PIG generator performs the real time weighted averaging to select one pixel out of nine pixels.

3. The EPG system of claim 2, further comprising a memory to buffer the generated pixels.

20 4. The EPG system of claim 3, wherein the memory buffers 3 adjacent pixels in a 3x3 sliding window for the current line and the previous two lines, and the PIG generator performs the real time weighted averaging to select one pixel out of the nine pixels from the sliding window.

25 5. The EPG system of claim 1, wherein the PIG generator performs a real time polynomial weighted averaging with binary coefficients.

30 6. The EPG system of claim 4, wherein the PIG generator in real time selects one pixel out of the nine pixels based on a transfer function of $(a + 2b + c + 2d + 4e + 2f + g + 2h + i)/16$, wherein a, b, c, d, e, f, g, h, and i are binary coefficients for the respective pixels in the 3x3 sliding window.

35 7. The EPG system of claim 1, further comprising means for displaying in the PIG window information about a television program.

8. The EPG system of claim 1, further comprising:
means for displaying television program listings in a first area of the screen;
an input device to selectively mark one of the displayed program listings; and

1 means responsive to the input device for controlling the display generator to display
in the PIG window simultaneously with the program listings video clips of the marked program.

5 9. The EPG system of claim 8, wherein the marked program is a currently telecast
television program and the video clip is a live telecast of the marked program.

10 10. The EPG system of claim 8, wherein the marked program is a future telecast
television program and the video clip is a preview of the marked program.

10 11. A television system for receiving a video signal, comprising:
a monitor having a display screen;
a plurality of tuners to generate a plurality of video signals that carry video
programs and data related to the video programs;
15 a PIG chip coupled to the monitor and the tuners to display a first image in a PIG
window on the screen based on a video signal generated by one of the plurality of tuners, wherein
the PIG chip performs a real time weighted averaging to select one pixel out of nine pixels from
the video signal to display the respective program in the PIG window on the screen; and
means for coupling the program related data to the PIG chip so as to display the
20 data in a second area on the screen contemporaneously with the program displayed in the PIG
window.

12. The television system of claim 11, further comprising a memory to buffer pixels
corresponding to a subset of the generated video signals.

25 13. The television system of claim 12, wherein the memory buffers 3 adjacent pixels
in a 3x3 sliding window for the current line and the previous two lines of the video signal
generated by one of the plurality of tuners, and the PIG chip performs the real time weighted
averaging to select one pixel out of the nine pixels in the sliding window.

30 14. The EPG system of claim 13, wherein the PIG chip in real time selects one pixel
out of the nine pixels based on a transfer function of $(a + 2b + c + 2d + 4e + 2f + g + 2h + i)/16$,
wherein a, b, c, d, e, f, g, h, and i are binary coefficients for the respective pixels in the 3x3
sliding window.

35 15. A method for providing video data to a picture in guide (PIG) window displayed
on a monitor, the method comprising the steps of:
receiving a video signal;
generating pixels based on the received signal;

1 performing a real time weighted averaging to select a subset of the pixels; and
displaying the subset of the pixels in the PIG window on the monitor.

5 16. The method of claim 15, further comprising the step of buffering the generated
pixels.

10 17. The method of claim 16, wherein the step of buffering comprises buffering 3
adjacent pixels in a 3x3 sliding window for the current line and the previous two lines, and the
step of performing a real time weighted averaging comprises performing the real time weighted
averaging for selecting one pixel out of the nine pixels in the sliding window.

15 18. The method of claim 17, wherein the step of performing a real time weighted
averaging comprises selecting one pixel out of the nine pixels based on a transfer function of $(a + 2b + c + 2d + 4e + 2f + g + 2h + i)/16$, wherein a, b, c, d, e, f, g, h, and i are binary coefficients
for the respective pixels in the 3x3 sliding window.

19. The method of claim 15, further comprising displaying in the PIG window
information about a television program.

20 20. The method of claim 15, further comprising:
displaying television program listings in a first area of the screen;
selectively marking one of the displayed program listings; and
controlling the display generator to display in the PIG window simultaneously with
the program listings video clips of the marked program.

25 21. The method of claim 20, wherein the marked program is a currently telecast
television program and the video clip is a live telecast of the marked program.

30 22. The method of claim 20, wherein the marked program is a future telecast television
program and the video clip is a preview of the marked program.

AMENDED CLAIMS

[received by the International Bureau on 15 August 2000 (15.08.00);
original claims 1 and 15 amended; remaining claims unchanged (3 pages)]

1. An electronic program guide (EPG) system including a picture in guide (PIG) window comprising:

a monitor having a display screen;

a tuner to generate a video signal;

a decoder coupled to the tuner to receive the video signal and generate pixels based on the received signal;

a PIG generator coupled to the decoder that performs a real time weighted averaging to [select] generate a subset of the pixels as a line of pixels is generated by the decoder; and

a display generator to display the subset of the pixels in the PIG window on the display screen.

2. The EPG system of claim 1, wherein the PIG generator performs the real time weighted averaging to select one pixel out of nine pixels.

3. The EPG system of claim 2, further comprising a memory to buffer the generated pixels.

4. The EPG system of claim 3, wherein the memory buffers 3 adjacent pixels in a 3x3 sliding window for the current line and the previous two lines, and the PIG generator performs the real time weighted averaging to select one pixel out of the nine pixels from the sliding window.

5. The EPG system of claim 1, wherein the PIG generator performs a real time polynomial weighted averaging with binary coefficients.

6. The EPG system of claim 4, wherein the PIG generator in real time selects one pixel out of the nine pixels based on a transfer function of $(a + 2b + c + 2d + 4e + 2f + g + 2h + i)/16$, wherein a, b, c, d, e, f, g, h, and i are binary coefficients for the respective pixels in the 3x3 sliding window.

7. The EPG system of claim 1, further comprising means for displaying in the PIG window information about a television program.

8. The EPG system of claim 1, further comprising:
means for displaying television program listings in a first area of the screen;

1 an input device to selectively mark one of the displayed program listings; and
 means responsive to the input device for controlling the display generator to display
in the PIG window simultaneously with the program listings video clips of the marked program.

5 9. The EPG system of claim 8, wherein the marked program is a currently telecast
television program and the video clip is a live telecast of the marked program.

10 10. The EPG system of claim 8, wherein the marked program is a future telecast
television program and the video clip is a preview of the marked program.

15 11. A television system for receiving a video signal, comprising:
 a monitor having a display screen;
 a plurality of tuners to generate a plurality of video signals that carry video
programs and data related to the video programs;
 a PIG chip coupled to the monitor and the tuners to display a first image in a PIG
window on the screen based on a video signal generated by one of the plurality of tuners, wherein
the PIG chip performs a real time weighted averaging to select one pixel out of nine pixels from
the video signal to display the respective program in the PIG window on the screen; and
 means for coupling the program related data to the PIG chip so as to display the
20 data in a second area on the screen contemporaneously with the program displayed in the PIG
window.

25 12. The television system of claim 11, further comprising a memory to buffer pixels
corresponding to a subset of the generated video signals.

30 13. The television system of claim 12, wherein the memory buffers 3 adjacent pixels
in a 3x3 sliding window for the current line and the previous two lines of the video signal
generated by one of the plurality of tuners, and the PIG chip performs the real time weighted
averaging to select one pixel out of the nine pixels in the sliding window.

35 14. The EPG system of claim 13, wherein the PIG chip in real time selects one pixel
out of the nine pixels based on a transfer function of $(a + 2b + c + 2d + 4e + 2f + g + 2h + i)/16$,
wherein a, b, c, d, e, f, g, h, and i are binary coefficients for the respective pixels in the 3x3
sliding window.

 15. A method for providing video data to a picture in guide (PIG) window displayed
on a monitor, the method comprising the steps of:
 receiving a video signal;

1 generating pixels based on the received signal;
 performing a real time weighted averaging to [select] generate a subset of the pixels
 as a line of pixels is generated by the decoder; and
 displaying the subset of the pixels in the PIG window on the monitor.

5 16. The method of claim 15, further comprising the step of buffering the generated pixels.

10 17. The method of claim 16, wherein the step of buffering comprises buffering 3 adjacent pixels in a 3x3 sliding window for the current line and the previous two lines, and the step of performing a real time weighted averaging comprises performing the real time weighted averaging for selecting one pixel out of the nine pixels in the sliding window.

15 18. The method of claim 17, wherein the step of performing a real time weighted averaging comprises selecting one pixel out of the nine pixels based on a transfer function of $(a + 2b + c + 2d + 4e + 2f + g + 2h + i)/16$, wherein a, b, c, d, e, f, g, h, and i are binary coefficients for the respective pixels in the 3x3 sliding window.

20 19. The method of claim 15, further comprising displaying in the PIG window information about a television program.

25 20. The method of claim 15, further comprising:
 displaying television program listings in a first area of the screen;
 selectively marking one of the displayed program listings; and
 controlling the display generator to display in the PIG window simultaneously with the program listings video clips of the marked program.

30 21. The method of claim 20, wherein the marked program is a currently telecast television program and the video clip is a live telecast of the marked program.

22. The method of claim 20, wherein the marked program is a future telecast television program and the video clip is a preview of the marked program.

35 CMR PAS266788.1-8/10/00 2:05 PM

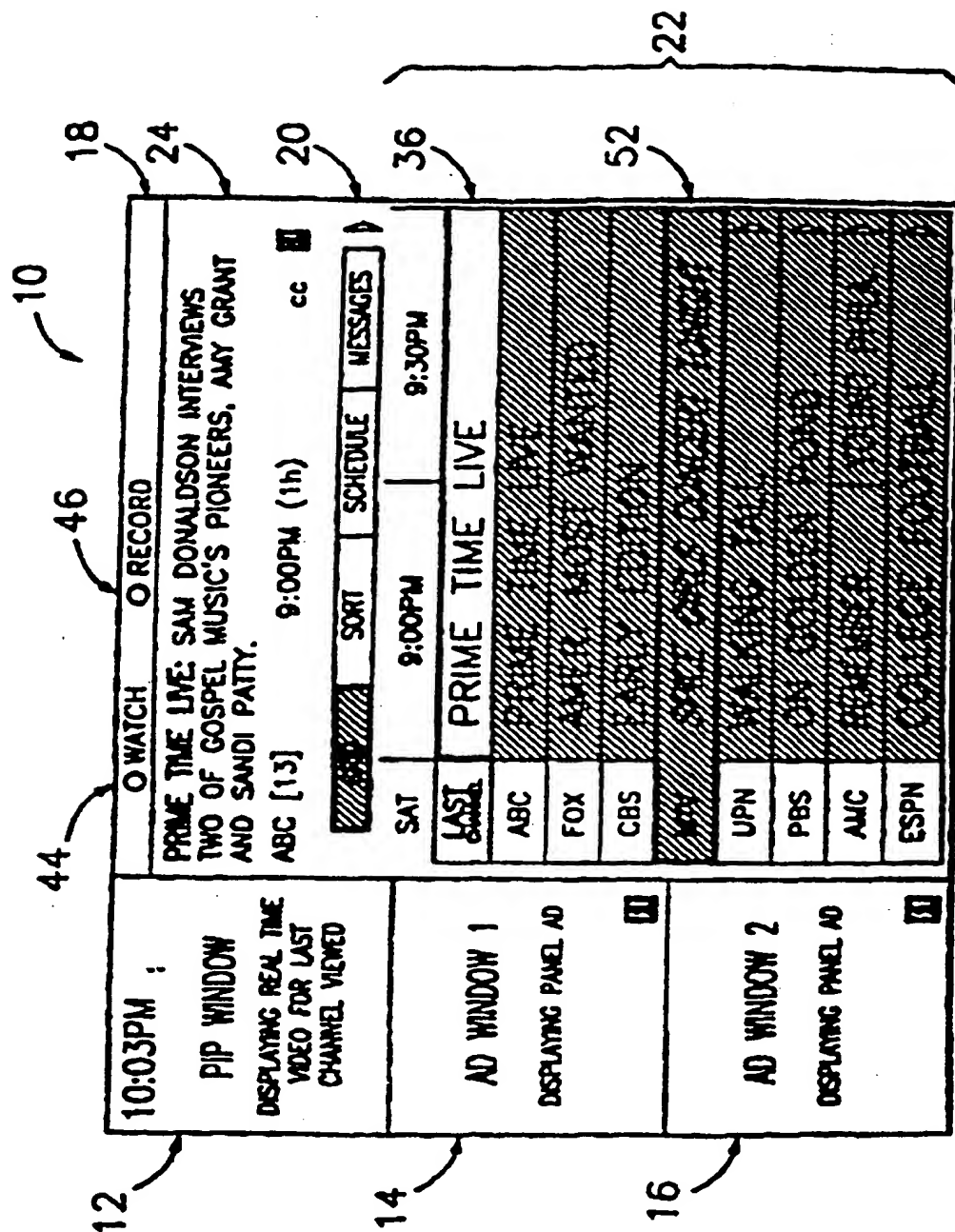


FIG. 1

2/3

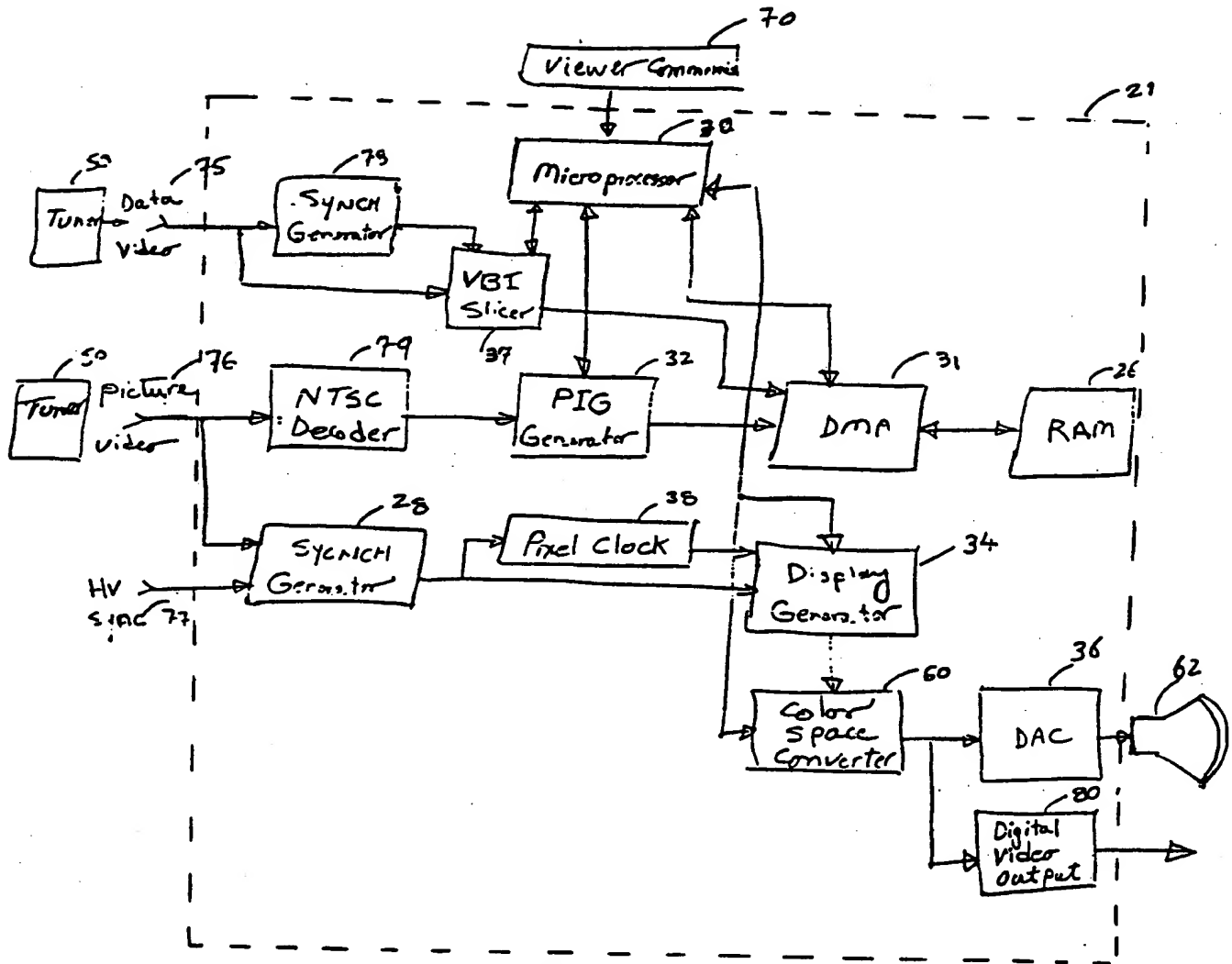


FIG. 2

3/3

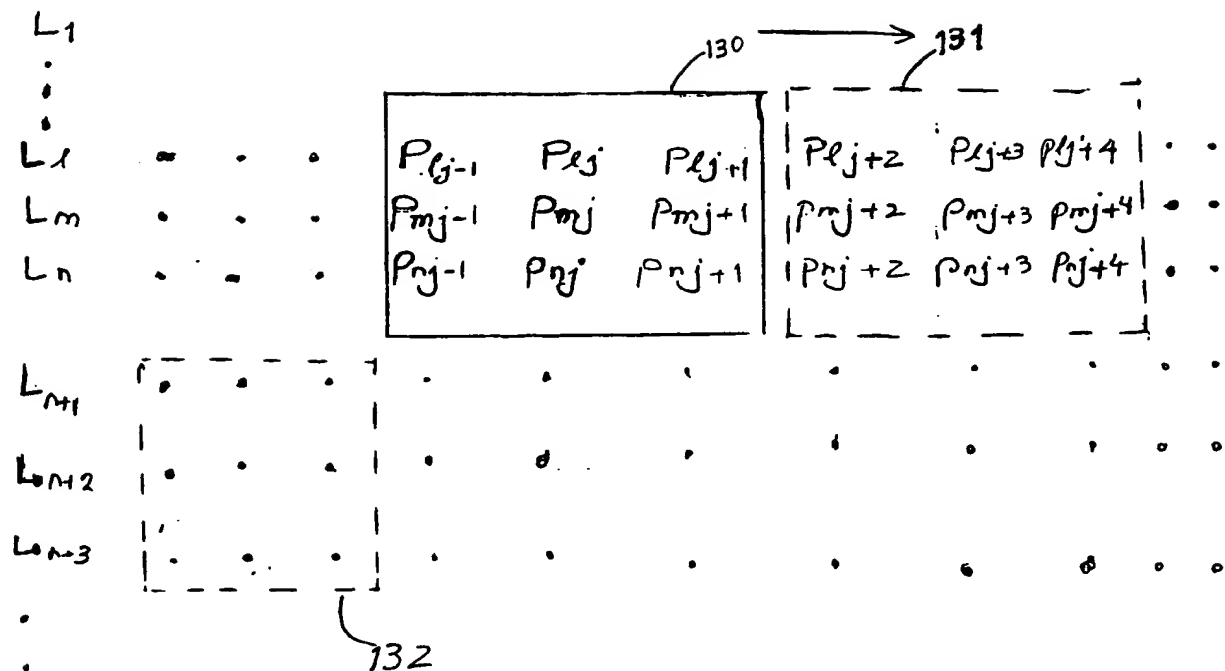


FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/08591

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N5/445

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 99 11061 A (SONY ELECTRONICS INC) 4 March 1999 (1999-03-04)	1, 15
A	the whole document	7, 11, 19
Y	US 4 779 135 A (JUDD THOMAS H) 18 October 1988 (1988-10-18)	1, 15
A	the whole document	2, 3, 11, 12, 16
A	WO 99 04561 A (SCHOAFF P CHRISTOPHER ; ALEXANDER RON (US); GUIDE INC E (US); HANCO) 28 January 1999 (1999-01-28)	8-11, 20-22
A	US 5 715 515 A (BANKER ROBERT O ET AL) 3 February 1998 (1998-02-03)	11
	the whole document	
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

23 June 2000

Date of mailing of the international search report

30/06/2000

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Authorized officer

Yvonnet, J

INTERNATIONAL SEARCH REPORT

Inter national Application No

PCT/US 00/08591

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 737 028 A (BERTRAM RANDALL LEE ET AL) 7 April 1998 (1998-04-07) the whole document -----	11

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 00/08591

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WO 9904561	A	28-01-1999	AU 8504898 A	10-02-1999
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US 5737028	A	07-04-1998	JP 9233400 A	05-09-1997

CORRECTED VERSION

(19) World Intellectual Property Organization
International Bureau(43) International Publication Date
5 October 2000 (05.10.2000)

PCT

(10) International Publication Number
WO 00/59213 A1

(51) International Patent Classification?: H04N 5/445

01915 (US). NG, Arthur, Y. [US/US]; 303 Bishop Forest Drive, Waltham, MA 02452 (US).

(21) International Application Number: PCT/US00/08591

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(22) International Filing Date: 31 March 2000 (31.03.2000)

(25) Filing Language: English

(81) Designated States (national): AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(26) Publication Language: English

(30) Priority Data:
60/127,270 31 March 1999 (31.03.1999) US

(71) Applicant (for all designated States except US): INDEX SYSTEMS, INC. [—/—]; P.O. Box 71, Craigmuir Chambers, Road Town, Tortola (VG).

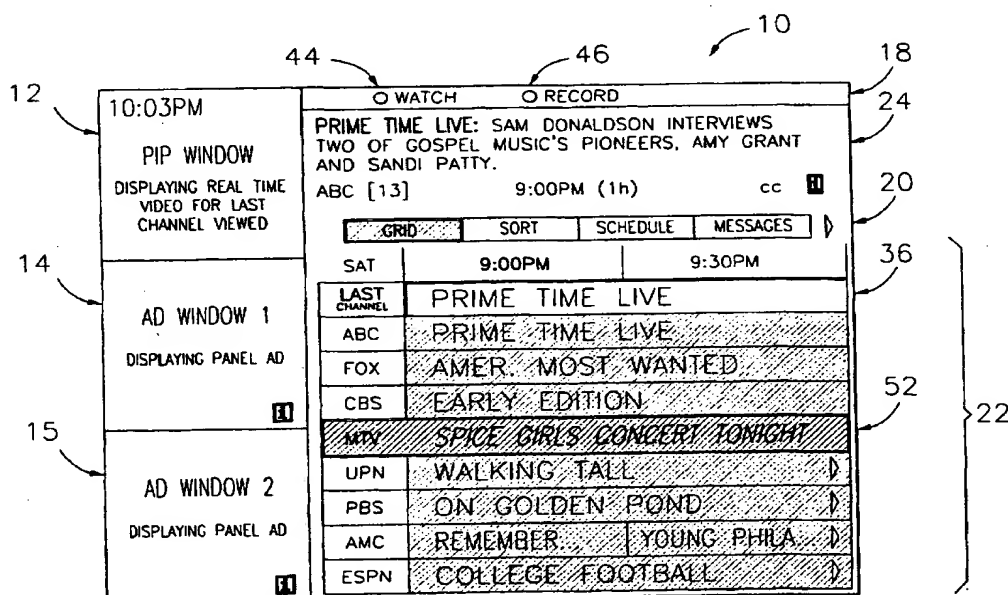
(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

(72) Inventors; and

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[Continued on next page]

(54) Title: DECIMATION METHOD FOR PROVIDING PIG WINDOWS



(57) Abstract: A decimation system and method for providing video data to a PIG window in a EPG environment. In one embodiment, the system includes an EPG system having a picture in guide window, a tuner to generate a video signal, a decoder coupled to the tuner to receive the video signal and generate pixels based on the received signal, a PIG generator coupled to the decoder that performs a real time weighted averaging to select a subset of the pixels; and a display generator to display the subset of the pixels in the PIG window on a monitor.

WO 00/59213 A1



Published:

*with international search report
with amended claims*

(15) Information about Correction:

see PCT Gazette No. 07/2002 of 14 February 2002, Section II

(48) Date of publication of this corrected version:

14 February 2002

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

DECIMATION METHOD FOR PROVIDING PIG WINDOWS

BACKGROUND OF THE INVENTION

The present invention relates generally to graphical/video display systems and methods, and in particular to methods and systems for optimizing graphical/video displays, such as Picture-In-Guide ("PIG") windows and their memory requirements.

Generally, televisions and television systems, such as computers to operate as televisions, provide information to a user through a display. One example is an electronic program guide ("EPG"). An EPG provides a user or television viewer with updatable television schedule information in the form of an on-screen graphical display. The EPG may provide scheduling information for current and future broadcast programs as well as summaries of television program content for a particular program. The EPG may also provide one or more regions (windows) for previewing different television programs simultaneous with the displayed schedule information or with broadcast of the television program. Often the EPG divides the display into multiple portions or regions of varying size and resolution to provide multiple types of information.

Conventionally, most television systems do not optimally use their available resources, such as memory space or processor bandwidth to effectively and efficiently provide information through the PIG window to a user. Therefore, there is a need for a method and system for providing a real-time and high quality video in a smaller PIG screen with minimum memory requirement.

SUMMARY OF THE INVENTION

The present invention is a decimation system and method for providing video data to a PIG window. One video pixel for every several video pixels is output, in real time, for the PIG window based on some (pixel) averaging algorithms. In one embodiment, only the two previous pixel lines are buffered, eliminating the need for buffering of the entire frame. This system produces real-time and high quality video in a smaller PIG screen with minimum memory requirement.

In one embodiment, the system of the present invention includes an EPG system having a picture in guide window, a tuner to generate a video signal, a decoder coupled to the tuner to receive the video signal and generate pixels based on the received signal, a PIG generator coupled to the decoder that performs a real time weighted averaging to select a subset of the pixels; and a display generator to display the subset of the pixels in the PIG window on a monitor.

Many of the features of this invention will be more readily appreciated as the same becomes better understood by reference to the following detailed description and considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exemplary PIG display of an EPG according to one embodiment of the present invention;

FIG. 2 is a simplified exemplary block diagram of a television system that includes a decimation system according to one embodiment of the present invention;

FIG. 3 is an exemplary averaging window for three pixel lines according to one embodiment of the present invention.

DETAIL DESCRIPTION

This invention relates to a decimation system and method for providing video data to a PIG window, preferably in an EPG. In one embodiment of the present invention, one video pixel for every several video pixels is output for the PIG window based on some (pixel) averaging algorithms. The earliest versions of on-screen EPGs provided for the storage of program schedule information in an electronic memory connected to the television receiver and generally provided for the on-screen formatting and display of the program schedule information on the television screen. The early EPGs typically overlaid the television programming. Later EPGs provided PIG display of the television program simultaneous with the display of the EPG. In PIG format, the moving, real time images of one television channel are displayed on the background of the EPG in a PIG window overlaid on a small area of the background.

The PIG display, according to one embodiment of the present invention, includes a real-time video image of a tuned television program displayed in a small window inset in a larger graphic guide. The PIG display provides many options to the viewer. The viewer may continue to view the television program s/he was watching before entering the guide while browsing through the television scheduling information in the guide. Alternatively, the program displayed in the PIG window may change for corresponding to a selected channel in the guide as the viewer cursors through program listings in the guide. The viewer may also pull up the PIG display to find out more information about the program s/he is currently watching, such as start/stop time or a program synopsis, while continuing to view the program in the inset PIG window.

FIG. 1 illustrates a PIG display 10 of an electronic program guide (EPG) including a grid portion 22 and a picture window 12. The picture window 12, hereafter referred to as the PIG window, contains a video image of the television program displayed in the full-screen video display, but in reduced size, generally reduced by a factor of three in both width and height, i.e., 1/9 the size of the screen. However, other reduction factors are also possible and are within the scope of the invention. Below window 12 are Panel Ad Windows 14, and 16 ("Ad Windows"). Windows 12, 14, and 16 each typically occupy about 1/9 of the total screen area. Another possible screen for display in a PIG system is a full-screen graphics display. The PIG window may also be used to display advertisement including text and video previews of goods, services, or television programs.

1 The grid portion 22 of the PIG display 10 takes up a majority of the screen. The grid
portion generally includes text, icons, and background graphics of several different colors. The
graphics may include highlighting of text or sections of the screen. In an EPG system, the viewer
can generally navigate through different guides without changing the television program
5 displayed in the PIG window 12. The remainder of the screen area is typically occupied (moving
from top to bottom of the screen) by an action key bar 18, a navigation bar 20, and an information
box 24 (the "detailed information area").

10 In one embodiment of the present invention, when the viewer places a cursor on a different
channel designation 52 or program title in the grid portion, the system automatically tunes the
associated tuner to the selected channel and displays the program broadcast on that channel in
the PIG window 12.

15 According to one embodiment of the invention, the components necessary to generate a
PIG display 10 are provided on a single chip to be incorporated into televisions, PC/TVs, VCRs,
stand-alone units, satellite receivers, or the like. By providing all the components on a single
chip, the overall package size can be reduced as well as the overall gate count and bus interface
size of that chip.

20 FIG. 2 is a block diagram of the components of one embodiment of the invention provided
on a single chip 21. These include a microprocessor 30, a memory controller or direct memory
access (DMA) device 31, synchronization regenerating (synch) circuitry 28 and 78, VBI slicer
37, NTSC decoder 79, PIG generator 32, pixel clock generator 38, display generator 34, color
space converter 60, digital-to-analog conversion (DAC) 36, digital video output 80.

25 The microprocessor 30 configures and coordinates the activities of all of the other
components on the chip 21 via two-way communication paths without participating in any data
movement operations, such as the VBI slicer 37 writing EPG data to memory via the DMA
engine 31. The microprocessor 30 accesses RAM 26 using the DMA engine 31 as a proxy by
providing address information and either providing data (in the case of a write) or receiving data
(in the case of a read).

30 Preferably, there is only one RAM, although this invention will work with any number of
RAMs. This RAM and the microprocessor 30 may be part of the chip 21 or may be external.
The decision of internal versus external RAM and/or microprocessor is driven by economic and
technological constraints. RAM 26 is accessed by four different components: the microprocessor
30, the PIG generator 32, the VBI slicer 37, and the display generator 34. This places a high
access load on the RAM as all four components may vie for access to the RAM simultaneously.
If all access requests cannot be satisfied simultaneously (either by using a RAM that can access
35 several bytes per cycle or using several RAMs or using a RAM whose cycle time is several times
faster than the chip cycle time), a multiplexing device is necessary to resolve the arbitration
between the components. Accordingly, the microprocessor 30, PIG generator 32, VBI slicer 37,
and the display generator 34 each access the RAM 26 through the DMA 31. The DMA is a

1 multiplexing and arbitrating circuit that facilitates the sharing of the RAM 26 by switching access
between the four components in turn. The DMA may include buffer memory to temporarily store
data input from out-of-turn components between access cycles. The DMA 31 stores text and
video data in the correct addresses in the RAM 26 and then retrieves the appropriate data from
5 a selected address from the RAM 26 when needed.

In one embodiment, the system can receive two independent video signals from two
independent tuners 50. In a unit with two tuners, this allows chip 21 to collect data from one
channel while the user is in the guide viewing a different channel. Other embodiments with more
than two tuners for receiving more than two video signals to display in a plurality of PIG
10 windows are also possible. In a unit with one tuner, both video inputs would be connected to the
one tuner.

The picture video input 76 from one of the tuners 50 is connected to the NTSC decoder
79. The NTSC decoder takes an analog input and outputs digital pixels either R,G,B or Y,U,V
in sufficient resolution for the desired PIG picture quality.

15 To implement a low-cost PIG device for use in a PIG system, the incoming video data is
decimated before the video data is stored in a memory device. Thus the resulting PIG has a
limited resolution. In one embodiment, a weighted averaging algorithm is used to select one
pixel out of nine pixels (decimation by 9). The incoming digitized video data is buffered in a
low-cost memory, such as a shift register, to carry out the averaging algorithm.

20 For example, for an immediate neighbor averaging, the adjacent pixels in a sliding
window (nine pixels) for the current line, the two previous lines are stored in the buffer (shift
register) and the desired averaging function is performed on them to obtain one weighted pixel
for each nine pixels. The resulting pixel is then converted to video signal for display in a PIG
window, or it is stored in memory to be used for PIG window display. For a nine pixel sliding
25 window, only two previous lines of video data need to be buffered.

Referring now to FIG. 3, sliding window 130 contains nine pixels. The two previous lines
l and m are buffered. When pixel P_{nj}+1 of the new line n arrives, the averaging algorithm is
performed, and the resulting (weighted) pixel is output in real time. When the next pixel P_{nj}+2
arrives, it is buffered but, the averaging algorithm is not performed until P_{nj}+3 and P_{nj}+4 arrive.
30 As P_{nj}+4 arrives, the sliding window shifts to the right by three pixels to position 131. The
averaging algorithm is performed and again, the next (weighted) pixel is output in real time.
When the end of line is reached, the sliding window moves down by three pixels to the
beginning of lines L_n+1, L_n+2, and L_n+3. No decimation is carried out until lines L_n+1 and
L_n+2 are buffered. Once lines L_n+1 and L_n+2 are buffered, the decimation continues as
35 indicated above.

The following illustrates an example for a polynomial weighted averaging algorithm:

Field	Line	Pixels								
1	1	1	2	3	4	5	6	7	8	9
2	1	1	2	3	4	5	6	7	8	9
1	2	1	2	3	4	5	6	7	8	9
2	2	1	2	3	4	5	6	7	8	9
1	3	1	2	3	4	5	6	7	8	9
2	3	1	2	3	4	5	6	7	8	9

As field 1, line 1 is received, pixels 1, 2, and 3 are summed together and stored, similarly for 4, 5, and 6 and 7, 8, and 9. The same procedure is used for line 3. The procedure is repeated for every line in field 1. When field 2 is received, field 2, line 1 is added to field 1, line 1 and field 1, line 3. Field 2, line 2 and field 2, line 3 are added to field 1, line 3, etc.

Note: pixel locations are marked (field-line-pixel). A field is assumed to have lines 1 - 240 inclusive active video lines. Each line is assumed to have 640 pixels.

The locations in memory after the first field is received would be:

memory[1] = (1-1-1) + 2*(1-1-2) + (1-1-3) + (1-2-1) + 2*(1-2-2) + (1-2-3)

memory[2] = (1-1-4) + 2*(1-1-5) + (1-1-6) + (1-2-7) + 2*(1-2-8) + (1-2-9)

...

...

memory[213] = (1-1-637) + 2*(1-1-638) + (1-1-639) + (1-2-637) + 2*(1-2-638) + (1-2-639)

memory[214] = 2*(1-3-1) + 4*(1-3-2) + 2*(1-3-3)

memory[215] = 2*(1-3-4) + 4*(1-3-5) + 2*(1-3-6)

...

memory[426] = 2*(1-3-637) + 4*(1-3-638) + 2*(1-3-639)

...

memory[33868] = 2*(1-240-1) + 4*(1-240-2) + 2*(1-240-3)

...

memory[34080] = 2*(1-240-637) + 4*(1-240-638) + 2*(1-240-639)

As the second field is received, the following pixels are output:

pixel[1] = {memory[1] + 2*(2-1-1) + 4*(2-1-2) + 2*(2-1-3)}/16

pixel[2] = {memory[2] + 2*(2-1-4) + 4*(2-1-5) + 2*(2-1-6)}/16

...

pixel[213] = {memory[213] + 2*(2-1-637) + 4*(2-1-638) + 2*(2-1-639)}/16

pixel[214] = {memory[214] + (2-2-1) + 2*(2-2-2) + (2-2-3) + (2-3-1) + 2*(2-3-2) + (2-3-3)}/16

...

1 The memory is updated with terms involving field 2 only.

memory[1] = $2*(2-1-1) + 4*(2-1-2) + 2*(2-1-3)$

memory[2] = $2*(2-1-4) + 4*(2-1-5) + 2*(2-1-6)$

...

5 memory[213] = $2*(2-1-637) + 4*(2-1-638) + 2*(2-1-639)$

memory[214] = $(2-2-1) + 2*(2-2-2) + (2-2-3) + (2-3-1) + 2*(2-3-2) + (2-3-3)$

...

As the next field 1 is received the output pixels are:

10 pixel[1] = {memory[1] + (1-1-1) + $2*(1-1-2) + (1-1-3) + (1-2-1) + 2*(1-2-2) + (1-2-3)$ }/16
and so on....

This algorithm converts every nine pixels into one pixel using polynomial weighted averaging with binary coefficients, without having to store the entire frames. As a result, a PIG window of a one-ninth the size of the original display window is generated. The picture is de-interlaced before the averaging and then re-interlaced after the averaging is completed.

Assuming the binary coefficients for the nine-pixel window are

a, b, c,

d, e, f,

g, h, i,

20 in one embodiment, the transfer function performed by the algorithm is: $(a + 2b + c + 2d + 4e + 2f + g + 2h + i)/16$. The averaging algorithm is performed in real time before the video data is stored. A minimum amount of memory is needed because only the two previous lines of each field, sufficient for carrying out the algorithm, are stored. The algorithm also counter balances the motion effects by assigning a heavier weight to the center pixel (i.e., 4e).

25 It will be recognized by those skilled in the art that various modifications may be made to the illustrated and other embodiments of the invention described above, without departing from the broad inventive scope thereof. It will be understood therefore that the invention is not limited to the particular embodiments or arrangements disclosed, but is rather intended to cover any changes, adaptations or modifications which are within the scope and spirit of the invention
30 as defined by the appended claims.

35

1 WHAT IS CLAIMED IS:

1. An electronic program guide (EPG) system including a picture in guide (PIG) window comprising:

5 a monitor having a display screen;
a tuner to generate a video signal;
a decoder coupled to the tuner to receive the video signal and generate pixels based on the received signal;

10 a PIG generator coupled to the decoder that performs a real time weighted averaging to select a subset of the pixels; and
a display generator to display the subset of the pixels in the PIG window on the display screen.

15 2. The EPG system of claim 1, wherein the PIG generator performs the real time weighted averaging to select one pixel out of nine pixels.

3. The EPG system of claim 2, further comprising a memory to buffer the generated pixels.

20 4. The EPG system of claim 3, wherein the memory buffers 3 adjacent pixels in a 3x3 sliding window for the current line and the previous two lines, and the PIG generator performs the real time weighted averaging to select one pixel out of the nine pixels from the sliding window.

25 5. The EPG system of claim 1, wherein the PIG generator performs a real time polynomial weighted averaging with binary coefficients.

30 6. The EPG system of claim 4, wherein the PIG generator in real time selects one pixel out of the nine pixels based on a transfer function of $(a + 2b + c + 2d + 4e + 2f + g + 2h + i)/16$, wherein a, b, c, d, e, f, g, h, and i are binary coefficients for the respective pixels in the 3x3 sliding window.

35 7. The EPG system of claim 1, further comprising means for displaying in the PIG window information about a television program.

8. The EPG system of claim 1, further comprising:
means for displaying television program listings in a first area of the screen;
an input device to selectively mark one of the displayed program listings; and

1 means responsive to the input device for controlling the display generator to display
in the PIG window simultaneously with the program listings video clips of the marked program.

5 9. The EPG system of claim 8, wherein the marked program is a currently telecast
television program and the video clip is a live telecast of the marked program.

10 10. The EPG system of claim 8, wherein the marked program is a future telecast
television program and the video clip is a preview of the marked program.

15 11. A television system for receiving a video signal, comprising:
a monitor having a display screen;
a plurality of tuners to generate a plurality of video signals that carry video
programs and data related to the video programs;
a PIG chip coupled to the monitor and the tuners to display a first image in a PIG
window on the screen based on a video signal generated by one of the plurality of tuners, wherein
the PIG chip performs a real time weighted averaging to select one pixel out of nine pixels from
the video signal to display the respective program in the PIG window on the screen; and
means for coupling the program related data to the PIG chip so as to display the
data in a second area on the screen contemporaneously with the program displayed in the PIG
window.

20 12. The television system of claim 11, further comprising a memory to buffer pixels
corresponding to a subset of the generated video signals.

25 13. The television system of claim 12, wherein the memory buffers 3 adjacent pixels
in a 3x3 sliding window for the current line and the previous two lines of the video signal
generated by one of the plurality of tuners, and the PIG chip performs the real time weighted
averaging to select one pixel out of the nine pixels in the sliding window.

30 14. The EPG system of claim 13, wherein the PIG chip in real time selects one pixel
out of the nine pixels based on a transfer function of $(a + 2b + c + 2d + 4e + 2f + g + 2h + i)/16$,
wherein a, b, c, d, e, f, g, h, and i are binary coefficients for the respective pixels in the 3x3
sliding window.

35 15. A method for providing video data to a picture in guide (PIG) window displayed
on a monitor, the method comprising the steps of:
receiving a video signal;
generating pixels based on the received signal;

1 performing a real time weighted averaging to select a subset of the pixels; and
displaying the subset of the pixels in the PIG window on the monitor.

5 16. The method of claim 15, further comprising the step of buffering the generated
pixels.

10 17. The method of claim 16, wherein the step of buffering comprises buffering 3
adjacent pixels in a 3x3 sliding window for the current line and the previous two lines, and the
step of performing a real time weighted averaging comprises performing the real time weighted
averaging for selecting one pixel out of the nine pixels in the sliding window.

15 18. The method of claim 17, wherein the step of performing a real time weighted
averaging comprises selecting one pixel out of the nine pixels based on a transfer function of $(a + 2b + c + 2d + 4e + 2f + g + 2h + i)/16$, wherein a, b, c, d, e, f, g, h, and i are binary coefficients
for the respective pixels in the 3x3 sliding window.

19. The method of claim 15, further comprising displaying in the PIG window
information about a television program.

20 20. The method of claim 15, further comprising:
displaying television program listings in a first area of the screen;
selectively marking one of the displayed program listings; and
controlling the display generator to display in the PIG window simultaneously with
the program listings video clips of the marked program.

25 21. The method of claim 20, wherein the marked program is a currently telecast
television program and the video clip is a live telecast of the marked program.

30 22. The method of claim 20, wherein the marked program is a future telecast television
program and the video clip is a preview of the marked program.

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AMENDED CLAIMS

[received by the International Bureau on 15 August 2000 (15.08.00);
original claims 1 and 15 amended; remaining claims unchanged (3 pages)]

1. An electronic program guide (EPG) system including a picture in guide (PIG) window comprising:
 - a monitor having a display screen;
 - a tuner to generate a video signal;
 - a decoder coupled to the tuner to receive the video signal and generate pixels based on the received signal;
 - a PIG generator coupled to the decoder that performs a real time weighted averaging to [select] generate a subset of the pixels as a line of pixels is generated by the decoder; and
 - a display generator to display the subset of the pixels in the PIG window on the display screen.
2. The EPG system of claim 1, wherein the PIG generator performs the real time weighted averaging to select one pixel out of nine pixels.
3. The EPG system of claim 2, further comprising a memory to buffer the generated pixels.
4. The EPG system of claim 3, wherein the memory buffers 3 adjacent pixels in a 3x3 sliding window for the current line and the previous two lines, and the PIG generator performs the real time weighted averaging to select one pixel out of the nine pixels from the sliding window.
5. The EPG system of claim 1, wherein the PIG generator performs a real time polynomial weighted averaging with binary coefficients.
6. The EPG system of claim 4, wherein the PIG generator in real time selects one pixel out of the nine pixels based on a transfer function of $(a + 2b + c + 2d + 4e + 2f + g + 2h + i)/16$, wherein a, b, c, d, e, f, g, h, and i are binary coefficients for the respective pixels in the 3x3 sliding window.
7. The EPG system of claim 1, further comprising means for displaying in the PIG window information about a television program.
8. The EPG system of claim 1, further comprising:
means for displaying television program listings in a first area of the screen;

1 an input device to selectively mark one of the displayed program listings; and
means responsive to the input device for controlling the display generator to display
in the PIG window simultaneously with the program listings video clips of the marked program.

5 9. The EPG system of claim 8, wherein the marked program is a currently telecast
television program and the video clip is a live telecast of the marked program.

10 10. The EPG system of claim 8, wherein the marked program is a future telecast
television program and the video clip is a preview of the marked program.

11. A television system for receiving a video signal, comprising:
a monitor having a display screen;
a plurality of tuners to generate a plurality of video signals that carry video
programs and data related to the video programs;
15 a PIG chip coupled to the monitor and the tuners to display a first image in a PIG
window on the screen based on a video signal generated by one of the plurality of tuners, wherein
the PIG chip performs a real time weighted averaging to select one pixel out of nine pixels from
the video signal to display the respective program in the PIG window on the screen; and
means for coupling the program related data to the PIG chip so as to display the
20 data in a second area on the screen contemporaneously with the program displayed in the PIG
window.

12. The television system of claim 11, further comprising a memory to buffer pixels
corresponding to a subset of the generated video signals.

25 13. The television system of claim 12, wherein the memory buffers 3 adjacent pixels
in a 3x3 sliding window for the current line and the previous two lines of the video signal
generated by one of the plurality of tuners, and the PIG chip performs the real time weighted
averaging to select one pixel out of the nine pixels in the sliding window.

30 14. The EPG system of claim 13, wherein the PIG chip in real time selects one pixel
out of the nine pixels based on a transfer function of $(a + 2b + c + 2d + 4e + 2f + g + 2h + i)/16$,
wherein a, b, c, d, e, f, g, h, and i are binary coefficients for the respective pixels in the 3x3
sliding window.

35 15. A method for providing video data to a picture in guide (PIG) window displayed
on a monitor, the method comprising the steps of:
receiving a video signal;

1 generating pixels based on the received signal;
 performing a real time weighted averaging to [select] generate a subset of the pixels
as a line of pixels is generated by the decoder; and
 displaying the subset of the pixels in the PIG window on the monitor.

5 16. The method of claim 15, further comprising the step of buffering the generated pixels.

10 17. The method of claim 16, wherein the step of buffering comprises buffering 3 adjacent pixels in a 3x3 sliding window for the current line and the previous two lines, and the step of performing a real time weighted averaging comprises performing the real time weighted averaging for selecting one pixel out of the nine pixels in the sliding window.

15 18. The method of claim 17, wherein the step of performing a real time weighted averaging comprises selecting one pixel out of the nine pixels based on a transfer function of $(a + 2b + c + 2d + 4e + 2f + g + 2h + i)/16$, wherein a, b, c, d, e, f, g, h, and i are binary coefficients for the respective pixels in the 3x3 sliding window.

20 19. The method of claim 15, further comprising displaying in the PIG window information about a television program.

25 20. The method of claim 15, further comprising:
 displaying television program listings in a first area of the screen;
 selectively marking one of the displayed program listings; and
 controlling the display generator to display in the PIG window simultaneously with the program listings video clips of the marked program.

30 21. The method of claim 20, wherein the marked program is a currently telecast television program and the video clip is a live telecast of the marked program.

 22. The method of claim 20, wherein the marked program is a future telecast television program and the video clip is a preview of the marked program.

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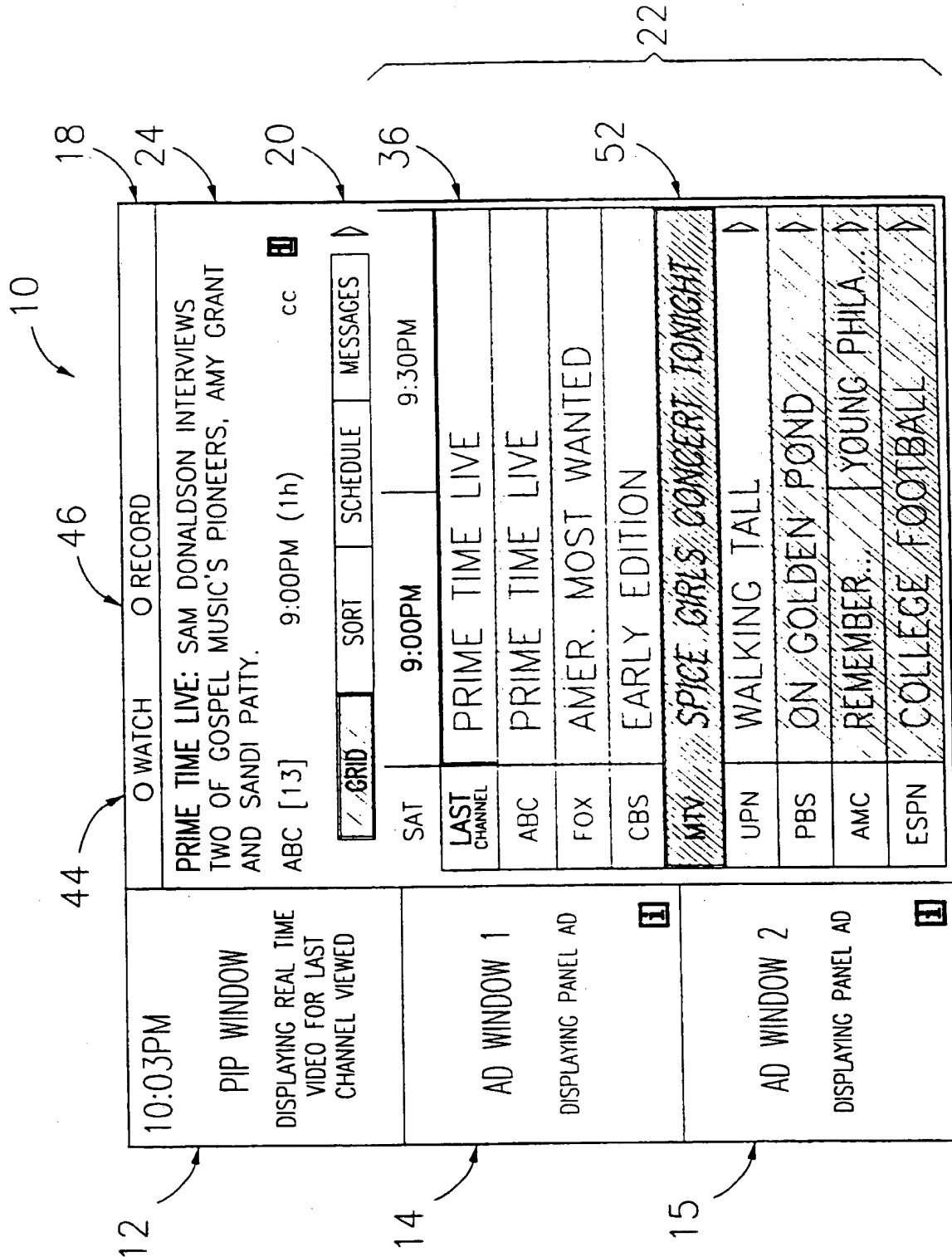


FIG. 1

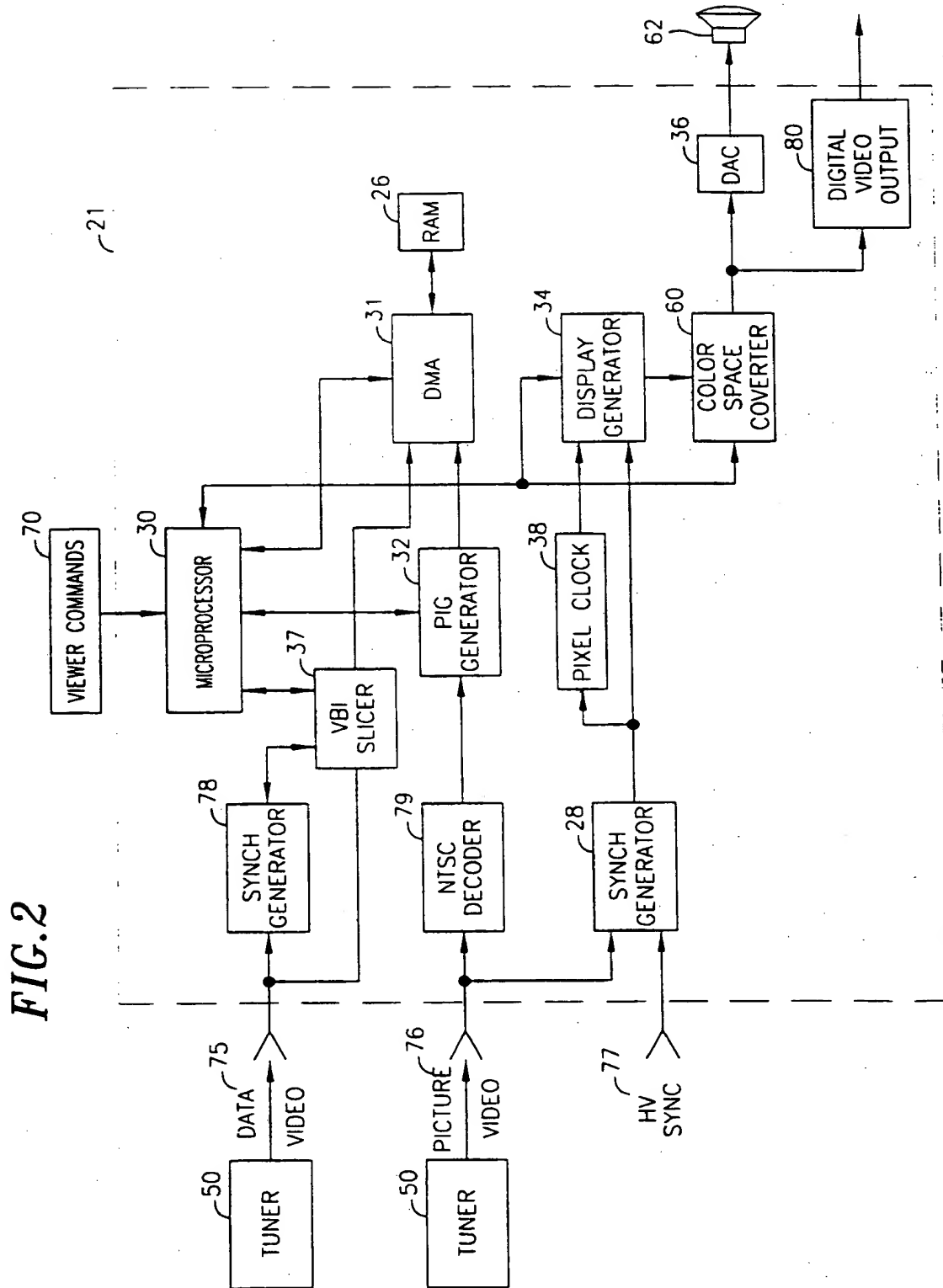
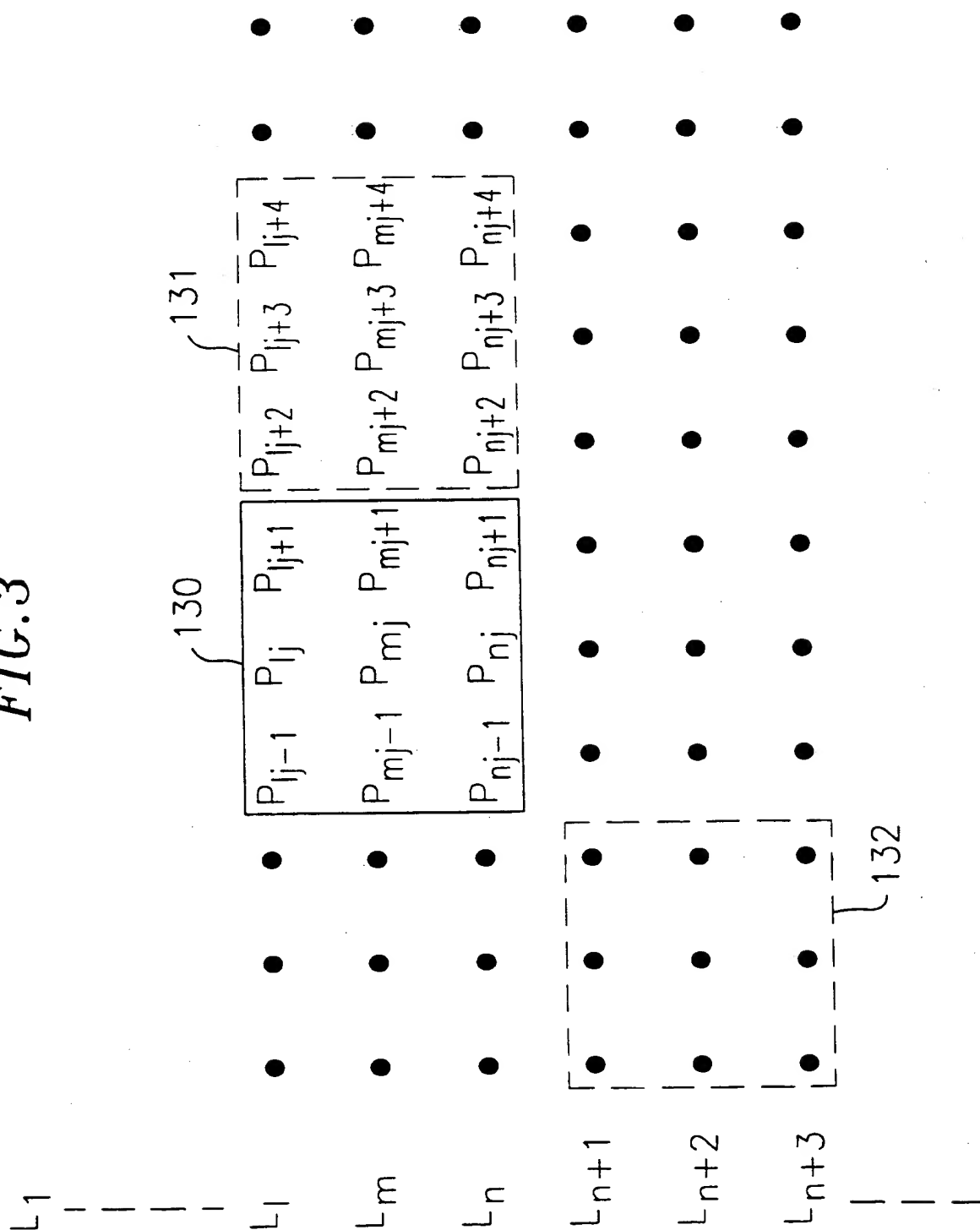


FIG. 3



INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/08591

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04N5/445

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 99 11061 A (SONY ELECTRONICS INC) 4 March 1999 (1999-03-04)	1, 15
A	the whole document	7, 11, 19
Y	US 4 779 135 A (JUDD THOMAS H) 18 October 1988 (1988-10-18)	1, 15
A	the whole document	2, 3, 11, 12, 16
A	WO 99 04561 A (SCHOAFF P CHRISTOPHER ; ALEXANDER RON (US); GUIDE INC E (US); HANCO) 28 January 1999 (1999-01-28)	8-11, 20-22
A	US 5 715 515 A (BANKER ROBERT O ET AL) 3 February 1998 (1998-02-03)	11
	the whole document	
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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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- *&* document member of the same patent family

Date of the actual completion of the international search

23 June 2000

Date of mailing of the international search report

30/06/2000

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INTERNATIONAL SEARCH REPORT

Inter nal Application No

PCT/US 00/08591

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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